DOCUMENT RESUME

ED 045 477 SO 000 331

AUTHOR Carroll, John B.; Spearritt, Donald
TITLE A Study of a "Model of School Learning." Monograph Number 4.
INSTITUTION Harvard Univ., Cambridge, Mass. Center for Research and Development in Educational Differences.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Cooperative Research Program.
PUB DATE 67
CONTRACT OEC-5-10-239
NOTE 18p.

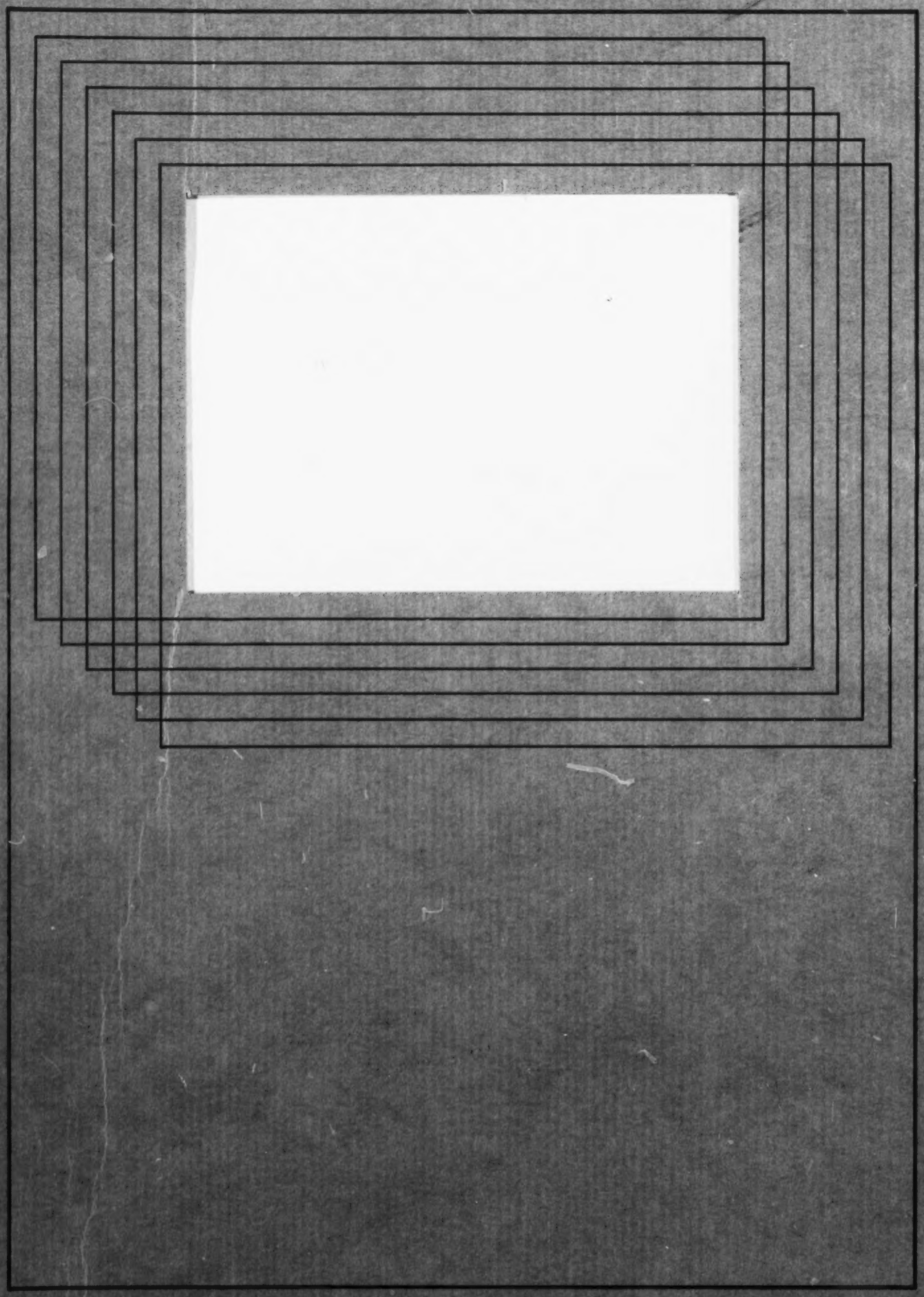
EDRS PRICE EDRS Price MF-$0.25 HC-$1.00
DESCRIPTORS Academic Aptitude, *Cognitive Ability, Experimental Teaching, Grade 6, Intelligence Quotient, Learning Characteristics, Learning Motivation, *Learning Processes, *Models, Task Performance, *Teaching Quality, *Time Factors (Learning)
IDENTIFIERS Carroll (John B)

ABSTRACT

A booklet of a programmed-instruction type was developed to obtain the measures needed to test Carroll's model of school learning, including ability, aptitude, quality of instruction, opportunity for learning, perserverance, and time criterion. Simple rules in an artificial foreign language were taught by means of the booklet to sixth-grade children. Poor quality instruction was found to retard the learning rate of children at all IQ levels, and to be almost as detrimental for children of higher intelligence as for children of lower intelligence. It also resulted in reduced perserverance among high IQ children but had no significant effect on the perserverance of children with IQ's of 115 or below. Statistics were developed to indicate the efficiency of learning under conditions of inadequate opportunity. The empirical data generally confirmed the trends hypothesized in Carroll's model. These findings, if confirmed in other studies, would emphasize the need for good teaching for the more able as well as the less able student. Learning was also shown to be highly inefficient when students had insufficient opportunity for learning. This suggests that learning efficiency measures should be established for children of different intelligence levels for given units of instruction. Such data would allow teachers to assess required amounts of learning time much more accurately than is possible at present. (Author)

ED045477

HARVARD R & D CENTER ON EDUCATIONAL DIFFERENCES



SP 000 231

EDO 45477

U.S. DEPARTMENT OF HEALTH, EDUCATION
& WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

Monograph Number 4

A STUDY OF A "MODEL OF SCHOOL LEARNING"

John B. Carroll
Donald Spearritt

Center for Research and Development on
Educational Differences

Harvard University
Cambridge, Massachusetts

1967

The research and development reported herein were performed pursuant to a contract (OE 5-10-239) with the Office of Education, U.S. Department of Health, Education, and Welfare, under the provisions of the Cooperative Research Program.

Additional copies may be obtained from the Publications Office, Longfellow Hall, Appian Way, Cambridge, Massachusetts 02138.

ACKNOWLEDGMENTS

The research described in this monograph was possible through the assistance and cooperation of the following: for the pilot study, Mr. David W. Hardy, director of the Cambridge School of Weston summer camp, Dr. Thomas L. Rivard, superintendent of schools, Chelmsford, Mass., and Mr. Robert Sinibaldi, principal of the McFarlin School in Chelmsford; for the principal study, Mr. Francis A. Kelly, superintendent of schools, Watertown, Mass., and Mr. William Corbett, principal of the James Russell Lowell School in Watertown; Mr. James FitzGerald, superintendent of schools, Waltham, Mass., and Miss Helen T. Flynn, principal of the Thomas R. Plympton School in Waltham; Mr. Edwin A. Nelson, superintendent of schools, Brockton, Mass., and Miss J. Evelyn McCarthy, principal of the Hancock School in Brockton. The research staff was aided also by the cooperation of the teachers whose students participated in the study.

During the past year, studies have been undertaken under the aegis of the Center for Research and Development on Educational Differences to test and refine various aspects of Carroll's "model of school learning." This model was originally proposed in the context of studies of foreign language learning (Carroll, 1962), was presented in a more general form in the Teachers College Record (Carroll, 1963), and has been partially validated in a recent study of foreign language training in the Peace Corps (Carroll, 1966). It was hoped that the model would suggest ways of understanding the complexities of pupil achievement and would also lead to new procedures for better organizing instruction to meet the needs of students. This paper reports the main findings of one of these studies.[1]

The Model

According to the Carroll model a complex learning task is regarded as being composed of a series of sub-tasks which may be learned with varying degrees of perfection. The degree of learning is measured in terms of the amount of success achieved over a fixed period of time, which may range from minutes for short-term learning tasks to weeks or even months for more complex tasks. Five variables in two main classes are conceived to influence the degree of learning; they may be outlined as follows:

Instructional variables

1. Quality of instruction (adequacy with which the task is presented);

2. Opportunity (time allowed for learning the task).

Individual difference variables

3. Student aptitude for learning the task (measured in terms of the time the student needs to learn the task to a specified criterion of learning, but also in many cases predictable from measures of ability and prior achievement that can be obtained before the student begins learning the task);

---

[1]The study was carried out principally by Donald Spearritt (Harvard Ed. D., 1961), who spent a year at the Center on leave from his regular position as Associate Professor in the Department of Education at the University of Sydney, Australia.

4. Student ability to understand instruction (a combination of general intelligence and verbal ability);

5. The student's "perseverance" -- the time he is willing to spend in learning.

The amount of learning, expressed in percent of criterion reached, is a function of how much time the learner actually spends in learning in relation to the amount of time he needs to learn, this latter quantity being a complex function of the quality of instruction, the student's aptitude, and his ability to understand instruction. The efficiency of learning, expressed as a percentage, is a function of the relation between the students' optimal rate of learning and the rate at which he actually learns. The product of the amount and efficiency of learning can be used as an overall measure of achievement from the standpoint of the school's success in promoting learning.

To make this model a little more concrete, suppose that we have a student who needs 10 hours to learn a particular task (eg. how to do long division, starting from a knowledge of simple division) if he is given the best quality of instruction available, and if he actually spends the 10 hours necessary. The fact that it would take this student 10 hours to learn the task reflects the student's aptitude. Ten hours might be an average time to learn such a task; students of higher aptitude might take a shorter length of time, while students of poorer aptitude might take much longer -- and some might never learn it at all, needing an "infinite" amount of time to do so.

The student who needs 10 hours to learn and actually spends 10 hours on the task learns 100% of the task, and he is also learning at 100% efficiency because his rate of learning is as high as his aptitude permits. But not all students complete their learning, nor do all learn at 100% efficiency. What are the conditions that would reduce amount of learning and learning efficiency?

Even under optimal quality of instruction, a student might not, for any one of a number of reasons, be willing to spend as much time as he needs to learn. If our student spent only five hours, he would learn only 50% of the task (assuming that equal amounts are learned in equal times), although he might be learning at 100% efficiency during the five hours. (Actually, he might spread his five hours over a longer period, and this would be legitimate if he has other useful things to do during this longer period.) We are not immediately interested in the reasons why the student does not spend the needed time; these reasons are usually allied with what is called the student's "motivation." Our hypothesis is that, holding quality of instruction constant, the amount of learning is solely a function of

the amount of time spent, and is independent of whether the student is "motivated" or not. And indeed, research has tended to show that the amount that a student learns, as long as he spends the requisite amount of time on the task, is largely independent of whether he likes the material or whether he "wants to learn."

But it is not always the student himself who limits the amount of time he spends on learning. Sometimes external factors do this. We summarize these external factors under the concept of "opportunity to learn." If the student needs 10 hours to learn but is permitted only five hours before he is tested or made to start a new phase of instruction, his amount of learning is again 50%. By failing to give individually-prescribed amounts of time for learning, or by giving all students arbitrarily fixed amounts of time, the school often drastically reduces the amount of learning.

Now suppose that the quality of instruction is less than optimal. That is, suppose the material presented is unnecessarily confusing or unclear, or the task requirements are not adequately spelled out. In all probability, this will lengthen the amount of time the student will need to learn, because it will take him longer to figure out what is required of him and how to learn the task. Just how much longer the student will need may depend in part on his intelligence and overall ability to understand instruction. There is some educational research that suggests that bright students are not as much affected by instruction of poor quality as are the less bright students. The model proposes, then, that the increased amount of time that the student will need is in inverse proportion to his general intelligence and ability to understand instruction interacting with the quality of instruction. If our student is bright, perhaps the poorer quality of instruction will increase his needed learning time to 12 hours, whereas for a dull student it might increase it to 20 hours.[2] Lengthening the amount of time needed will reduce the efficiency of learning. For the student who will take 12 hours, efficiency is 10/12 or 83%, while for the student who will take 20 hours, it is 10/20 or 50%. And if the student fails to spend the lengthened amount of time, the amount of learning is decreased correspondingly. For example, the student who works only six hours, though he needs 12, learns only 50% of the material, and since the efficiency of the learning is only 83%, the net percentage of success is (100) (.83 x .50) = 41.6%.

---

[2]All these figures are hypothetical, of course, being given only to make the discussion concrete and more readily understandable.

A Study of the Model

The above description is given in very general terms. In order to make a specific test of the model, we decided to apply it to a simple learning task of the sort that might be found in a school situation. One aim of the study was to investigate the possibility of establishing learning efficiency measures for various levels of intelligence and quality of instruction. Another was to obtain information about the effects on learning of variation in certain of the independent variables included in the model; sex was included as an additional independent classification variable as a matter of general rather than specific experimental interest. The form of learning curve itself was examined for different levels of intelligence and quality of instruction, as the appropriate data were obtained in the process of determining the time needed by children to learn a task to criterion.

Answers were sought to the following questions:

1. Does the time taken to reach criterion in a verbal learning task differ according to sex, level of intelligence, quality of instruction, and the interaction of these variables?

2. Does the amount of time children are willing to spend on a task vary according to their sex, level of intelligence, quality of instruction received, and the interaction of these variables?

3. Does the time taken to reach criterion differ according to sex, level of intelligence, quality of instruction, and the interaction of these variables when "time willing to spend" is controlled?

4. What degree of learning is achieved by children of differing levels of intelligence under conditions of good and poor quality instruction when insufficient time is allowed for learning?

5. To what degree is the interest expressed by children at the completion of a learning task related to their performance on the task, their level of intelligence, and the quality of instruction received?

The Learning Task

For a preliminary test of the model, it seemed appropriate to choose a learning task which would involve the type of learning undertaken in an ordinary school lesson, but which was based on material not

familiar to school children. The task selected was a simple modification of a program designed to teach a few rules about an artificial foreign language labeled "Midimo." The task requires the learning and application of the following simple rules about verbs in the language:

1. Verbs must contain six letters;

2. The first, third, and fifth letters must be vowels (a, i, o, or u) and the second, fourth, and sixth letters must be consonants (p, s, d, v, or m);

3. Verbs must begin with the letter "i" if they are in the present tense, with "a" if in the past tense, and with "o" if in the future tense.

Children are then required to select appropriate Midimo words for verbs presented in simple English sentences.

The development of reliable methods of assessing the quality of instruction being offered by teachers is one of the more complex problems to be faced in full-scale studies of the model of school learning. As this preliminary study was designed to examine the main effects and interactions of the independent variables in the model, the problem of teacher effects was avoided by presenting the task in a programmed instruction form. A self-administering booklet was devised to teach and test the various rules. To allow for differences in learning rates and in relative need for reinforcement of the rules, the booklet made use of the branching principle. In effect, a child would follow a sequence of steps in using the booklet:

1. He would read the rule or set of rules at the top of the page;

2. He would select from a number of Midimo words at the bottom of the page the one word which met the requirements of the rule(s) listed at the top of the page, and make a check mark in the box beside this word;

3. He would open out the page (which had been previously folded under) to find which page he should turn to next. If he needed further reinforcement on the particular rule, he would be directed to immediately following pages; if not, he would be directed to skip a number of pages, and to proceed to the page where the next rule was presented.

Two forms of the booklet were prepared to provide two different levels of quality of instruction. In Form A of the booklet, each rule is presented and tested before the next rule is introduced; if the child selects a wrong answer, his mistake is explained to him on the page to which he turns. Form B of the booklet was developed

to reflect a classroom technique which might be expected to result in a poorer quality of instruction, that is, the presentation of too much information at one time in a disorganized fashion combined with an inadequate explanation of mistakes. Thus, in Form B of the booklet, all rules were presented simultaneously in a disorganized sequence and in paragraph form instead of numbered statement form; if a child selected a wrong answer, this was pointed out to him on the page to which he turned, without explanation as to why he was wrong. After another presentation of the rules in a different disorganized sequence, he would be required to answer another question testing his knowledge of a particular rule. The two booklets differed only in the presentation of the rules, and in the amount of explanation of mistakes. The questions, the Midimo words, and the reading load were the same for both booklets, as were the number of additional practice pages for each rule. On an *a priori* basis, Form A was defined as high quality instruction and Form B as low quality instruction, and this was confirmed in a preliminary trial. A pre-test booklet was prepared to ensure that pupils understood what verbs were and that they could distinguish vowels from consonants. This booklet was also designed to teach pupils the meaning of the present, past, and future tense in the programmed form in which they would subsequently learn the Midimo language in the Form A or Form B booklet.

Measures of the time taken by children to reach various points in the booklet were required both to assess aptitude for learning the task and to observe the effect of allowing insufficient time for the task or insufficient opportunity for learning. These were obtained by including printed instructions at the top of certain pages in the booklets themselves, which asked children to enter in a box the time written on the blackboard, altered at half-minute intervals.

The instructional section of the task was completed in 59 pages in Forms A and B of the booklet, and children who made no errors would have answered eighteen key questions on pages 2, 7, 9, 14, 16, 19 etc. The time taken by the child to reach page 60 provided an indication of his rate of learning. His degreee of learning was assessed by an eight-item multiple choice test on page 60 in which he was required to determine the tense of the verb in an English sentence and select the appropriate Midimo word. As preliminary versions of the booklet showed that an appreciable proportion of children failed to reach a satisfactory level on this test, further intensive expository instruction was incorporated in pages 61 to 64 of the final booklet. This was followed by another eight-item multiple choice test on page 65 to assess the degree of learning at this stage, and by a six-item constructed response test on page 66 in which the child had to make up Midimo verbs in various tenses. These tests were followed by an eight-item transfer

test, in which the child was required to apply what he had learned by constructing words in the "Bukano" language (another artificial language) for English verbs in the different tenses. Bukano rules were similar to Midimo rules, but used some different letters and different initial letters to represent the tenses.

The next page of the booklet (Forms A and B) was designed to obtain a measure of the child's perseverance as the time he was willing to spend in a task of this kind. This is one of the independent variables in the model, but is treated in this study as a non-manipulated independent variable. It would have been possible to manipulate the variable by equating it with level of motivation, and providing extrinsic rewards to some groups and not to others. In terms of the model of school learning, however, it seems that what is required is an estimate of the child's general motivational set towards school tasks, that is, the time he is customarily willing to spend on a task of this kind. It therefore appeared preferable to measure the variable within the learning task itself. In order to accomplish this without affecting the more basic measures of the time required to learn the task under optimal motivational conditions, the measure of "time willing to spend" was obtained after the task was completed. As the variable could be expected to be closely associated with the difficulty of the task for the children, a task which was fairly difficult but not completely impossible for the brighter children seemed appropriate. The task developed for the purpose involved the simultaneous learning and application of a number of fairly complicated rules about Midimo words for singular and plural nouns used as the subject and object of a verb in English sentences. It was reasoned that children who had learned the verb rules quickly and successfully would be willing to spend more time on this task than children who had been less successful and that measures of "time willing to spend" obtained on this task would be highly correlated with measures that might have been obtained during the main learning task.

An estimate of the interest of the children in the task was obtained through the use of selected semantic differential scales on the second last page of the booklet. To keep the speedier children occupied while the others were completing the test, a final page incorporating puzzles of the scrambled word type was included, but this page was not scored.

The booklet was designed so that children would proceed through it sequentially, and they were not allowed to turn back to earlier pages. Failure to turn to the correct page or false recording of the times could easily be traced from the responses in the booklet itself. Preliminary trials of the booklet showed that the task was appropriate for children at the sixth grade level. These trials also indicated

the appropriate number of additional instructional pages required for each rule, and the amount of time children needed to work through the booklet. Most of the children tested could complete the pre-test booklet in 20 minutes or less, and the Form A or Form B booklet in 60 minutes or less.

Details of the Experiment

Subjects. The learning task was administered to eight classes of sixth grade children comprising 208 subjects in all. A list of the names of the children in these classes and of their IQ's was obtained beforehand from the school system concerned.[3] The names of the children in each class were divided into three groups, a "high intelligence" group (IQ's of 116 and above), an "above average" group (IQ's of 105 to 115) and an "average to low" intelligence group (IQ's of 104 and below), the cut-off points being selected to provide approximately equal numbers of boys and girls in each group. A table of random numbers was used to assign either Form A or Form B of the booklets to boys and girls within each of the intelligence groups.

Procedure. The children were informed that they were being given an interesting but unusual task to do, and were asked to do the task as well as they could. The Midimo pre-test booklet was explained to them, and they then proceeded to work through this booklet. After all children had completed the pre-test booklet, Forms A and B were distributed to the children within each class according to the previously prepared random assignment of names. It was pointed out to the children that they had different booklets and that they were likely to be working on different pages and turning over pages at different times. Their attention was drawn to the need for entering the time at various stages, and to the fact that the time would be changed continuously on the blackboard. The children appeared to be most interested in the task, and maintained their interest throughout the working period.

Design. A 3 x 2 x 2 factorial design was employed, with three levels of intelligence and two levels of quality of instruction and sex. Measures obtained on the non-manipulated independent variable of "time willing to spend" were used as covariates within the basic factorial design as well as in separate analyses.

Variables. Measures of IQ, quality of instruction, and sex were available for each child. In addition, the following measures (dependent variables) were obtained from each child's booklet:

---

[3] IQ's were based on the Lorge-Thorndike Intelligence Test in one school, on the Otis Quick-Scoring Mental Ability Test in another school, and on the California Test of Mental Maturity in a third school.

1. Time taken to complete each stage of the learning task;

2. Time taken to reach first recognition test;

3. Time taken to reach second recognition test;

4. Time taken to reach criterion (equivalent to Variables 2 or 3, and available only for those children who reached criterion);

5. Number of errors made during the learning task;

6. Raw score on first recognition test;

7. Raw score on second recognition test;

8. Raw score on constructed response test;

9. Raw score on transfer test;

10. Time child was willing to spend on the difficult post-experimental task.

11. Number of questions attempted and number correct on the difficult task;

12. Score on the semantic differential scale (to assess liking for the task).

RESULTS

1. Time to criterion.

It had been expected that "time to criterion" would not differ significantly for the two sexes but that it would be shorter for children of higher intelligence and for children receiving good quality instruction. It had also been expected that poor quality instruction would result in a relatively smaller increment in "time to criterion" for children of higher intelligence than for children of lower intelligence.

An operational definition of "reaching criterion" on the task had to be established. This was arbitrarily set at a score level of 6, 7 or 8 on either the first or second recognition test. Under this definition, 128 children reached criterion on the task and 57 failed to reach criterion. The responses of the remaining 23 subjects were not considered because of irregularities or inadvertent omissions in their test booklets. The criterion was reached by 70%

of boys, of girls, of Form A subjects and of Form B subjects. With respect to the intelligence groupings, it was reached by 90% of the "high intelligence" grouping, 66% of the "above average" grouping, and 52% of the "average to low" grouping. Of children in the high intelligence grouping, all reached criterion on Form A, as against 82% on Form B; of those in the above average grouping, 62% reached criterion on Form A compared with 69% on Form B; in the average to low IQ grouping, 50% reached criterion on Form A, compared with 53% on Form B.

In order to perform an analysis of variance in the 3 x 2 x 2 design with eight cases per cell, 96 cases who reached criterion were selected by randomly discarding cases in the higher IQ groups. Table 1 shows the mean times, in minutes, for these cases to reach criterion, separately for various classifications of cases. It will be seen that the children required less time to reach criterion under good quality of instruction than under poor quality of instruction, the difference being significant at the 5% level with $F(1, 84) = 5.42$. Also, "time to reach criterion" was significantly related to IQ, with $F(2, 84) = 7.74$, $p < .001$. The relationship to sex, however, was non-significant. Contrary to the prediction made by the model, there was no significant interaction between IQ and quality of instruction; high IQ children were just as much affected by the poor quality of instruction as were the average and low IQ children.

TABLE 1. Mean Time (minutes) Taken to Reach Criterion

	Form A (good QI)	Form B (poor QI)	Total group
HIGH IQ	19.44	23.06	21.25
ABOVE AVERAGE IQ	21.34	22.56	21.95
AVERAGE-LOW IQ	24.97	30.16	27.56
BOYS	21.62	25.33	23.48
GIRLS	22.21	25.19	23.70
TOTAL GROUP	21.92	25.26	23.59

The differences in the percentage of each IQ grouping who reached criterion suggests that the effect of IQ on the time taken to reach criterion is probably stronger than Table 1 indicates. If it had been practicable to allow sufficient time and provide sufficient practice for all of the 185 children to reach criterion, the disparity between higher and lower intelligence groups in the mean time taken to reach criterion would have been greater still.

Similar results were obtained when an analysis of the number of errors was made. That is, the mean number of errors was significantly greater under poor quality instruction than under good quality instruction, and the average to low IQ group had a significantly greater mean number of errors than the above average or high IQ groups, but there was no significant interaction between quality of instruction and IQ.

2. Time willing to spend ("perseverance")

Measures of this variable, it will be recalled, were times spent on a rather difficult task presented after the main learning task. The children were told to do "as much as you think you can" on it and then turn to the next page. Although 73% of the 198 children who reached this task attempted all of the three check questions in it, only five answered them all correctly, and 182 children scored either 0 or 1, perhaps not trying very hard to study the material and be accurate; apparently, then, the task was of appropriate difficulty for its purpose.

Table 2 shows the mean times, in minutes, that the children were willing to spend on the difficult task. Although boys and girls did not differ significantly, there was a significant effect of IQ and also a significant interaction between IQ and the quality of instruction on the main learning task, both at the 5% level. "Time willing to spend" was a direct function of IQ, but also, children who had received good quality instruction in the main learning task were more willing to spend time on the difficult task if they were high IQ or "average-to-low IQ" children, but not if they were in the middle, "above average IQ" category. This trend was true for both the boys and the girls separately, although the difference in the mean times for Form A and Form B was significant for the high IQ group only. The trend provides grounds for speculating that children in the middle IQ category have developed the habit of applying themselves more when they encounter difficult, poorly presented material, while those with high or low IQ's lose interest more rapidly. It suggests that the model might be modified to reflect the possibility that poor quality of instruction leads to reduced perseverance in the case of high or low IQ children, but to increased perseverance in the children of average intelligence.

TABLE 2. Mean Time (minutes) Children Were Willing to Spend on Difficult Task.

	Form A (good QI)	Form B (poor QI)	Total Group
HIGH IQ	5.25	3.88	4.56
ABOVE AVERAGE IG	3.34	4.13	3.73
AVERAGE-LOW IQ	3.94	2.88	3.41
BOYS	4.08	3.85	3.97
GIRLS	4.27	3.40	3.83
TOTAL GROUP	4.18	3.63	3.90

In the main learning task, all children were required to work at it until they completed it. The effect of "perseverance" as measured on the difficult, post-experimental task could therefore be studied only as a control variable. When the "times to reach criterion" in the main learning task were adjusted, by analysis of covariance, for differences in "time willing to spend," there was very little difference in the results. Table 3 shows these adjusted mean times for IQ and quality of instruction groups. IQ and quality of instruction were still significant effects (at the 1% and the 5% levels, respectively), and interaction between these main effects was not significant.

TABLE 3. Mean Times (minutes) Taken to Reach Criterion, Adjusted for Time Willing to Spend on a Difficult Task.

	Form A (good QI)	Form B (poor QI)	Total group
HIGH IQ	20.24	23.07	21.64
ABOVE AVERAGE IQ	21.01	22.70	21.85
AVERAGE-LOW IQ	24.99	29.56	27.27
TOTAL GROUP	22.09	25.10	23.59

"Time willing to spend" had low but significant correlations with IQ (.25 for 128 cases, .36 for 185 cases), first recognition score (.31, .47), time to criterion (-.23, -.22), and rate of work (.25, .25). There was thus a slight tendency for children who completed the initial learning task more quickly and more successfully to be willing to spend more time on the difficult task.

3. Efficiency of learning

Form A of the main learning task was intended to provide the best quality of instruction possible under the constraint that it would be presented in the form of a programmed booklet that could be administered to whole classes at once. In fact, it had gone through a number of preliminary trials in which various faults were eliminated as far as possible. Perhaps -- we do not know -- it could have been improved even more, but for the present purposes it may be regarded as instruction of optimal overall quality for those who reached criterion.[4] On this assumption, we may assume that all the children

[4]The question of whether it could have been improved by differentiating instruction in terms of special learner characteristics has not been considered in this research; further studies are being undertaken along these lines.

who completed Form A of the booklet to criterion learned at 100% efficiency. (See Table 4, first four rows in the first column.)

Form B of the main learning task was designed in such a way that it would systematically degrade the quality of instruction while holding constant such factors as reading load and vocabulary difficulty. In general, children of comparable IQ's took longer to complete Form B than Form A. On the assumption that the average times taken by children of given IQ groups to reach criterion in Form A represented the time they needed under optimal instruction, we can determine the efficiency of learning under Form B, the intended "poor quality" of instruction as the ratio of the time needed for Form A to the time needed for Form B. The resulting efficiency percentages are shown in the first four rows, second column of Table 4.

TABLE 4. Efficiency of Learning under Unlimited Time Conditions and under a Time Limit of 15 minutes.[5]

	Optimal Instruction (Form A)	Poor Quality Instruction (Form B)
UNLIMITED TIME		
HIGH IQ	100%	84.3%
ABOVE AVERAGE IQ	100%	94.6%
AVERAGE-LOW IQ	100%	82.8%
TOTAL GROUP	100%	86.8%
15 MINUTES TIME LIMIT		
HIGH IQ	77.2%	65.1%
ABOVE AVERAGE IQ	70.6%	66.8%
AVERAGE-LOW IQ	60.1%	49.8%
TOTAL GROUP	68.4%	59.4%

[5] In this table, the values are computed by dividing the average amount of time taken by a group by the average amount of time needed under the particular form of instruction. For example, the last value in the second column is (100) x 15/25.26 = 59.4%. The assumption is made that for any child, equal amounts are learned in equal times during the course of the learning.

Suppose, however, we limited the "opportunity to learn" by permitting the children to work at the task only, say, 15 minutes. Some children, in fact, completed the task in only 15 minutes. The analog in the normal school situation will come readily to mind: only so much time is available for a certain school task, and since some children complete it in the time allowed, the teacher assumes that this is a fair amount of time for all. On the basis of the results we have in this study, the average efficiency of learning would decrease markedly, particularly where instruction is poor, and particularly for children of lower aptitude. The second section of Table 4 gives the overall efficiency of learning figures for different IQ groups under good and poor instruction.

4. Interest in the task

What factors influence children's interest in a task of this sort? After the difficult learning task used to measure amount of time willing to spend on learning, the children were asked to rate the whole exercise on a series of evaluative semantic differential scales: foolish-wise, bright-dark, dishonest-honest, valuable-worthless, ugly-beautiful, interesting-boring, nice-awful, miserable-fine, bad-good, and clean-dirty. The most adverse rating would be represented by a score of 0, the most favorable by a score of 40. The average rating was 28.44 with a standard deviation of 7.03, indicating that the average evaluation was fairly positive, but that there was considerable range of opinion. Contrary to expectation, there was no significant difference in opinion between the two quality of instruction groups. However, IQ was significantly correlated ($r = .21$ for 140 cases) with evaluation, as was time willing to spend on a difficult task ($r = .22$). The highest correlation ($r = .29$) was attained for the "best recognition score," a post-experimental measure of achievement. Thus, there is a slight tendency for the more intelligent children and for those doing better on the criterion tests to express more interest in the task but on the whole, interest is a negligible factor in performance. It would seem that this factor does not have to be taken account of in the model.

SUMMARY

A booklet of a programmed-instruction type was developed to obtain the measures needed to test Carroll's model of school learning, viz. quality of instruction, opportunity for learning, perseverance, and time to criterion. Simple rules in an artificial foreign language were taught by means of the booklet to sixth-grade children. Poor quality instruction was found to retard the learning rate of children at all IQ levels, and to be almost as detrimental for children of higher intelligence as for children of lower intelligence. It also resulted in reduced perseverance among high IQ children but had no significant effect on the perseverance of children with IQ's of 115 or below. Statistics were developed to indicate the efficiency of learning under conditions of inadequate opportunity. The empirical data generally confirmed the trends hypothesized in Carroll's model.

In general terms, the study indicated that poor quality instruction depressed the performance of children at all intelligence levels, and that it led to reduced perseverance on the part of children of higher intelligence. These findings, if confirmed in other studies, would emphasize the need for good teaching for the more able as well as the less able student. Learning was also shown to be highly inefficient when students had insufficient opportunity for learning. This suggests that learning efficiency measures should be established for children of different intelligence levels for given units of instruction. Such data would allow teachers to assess required amounts of learning time much more accurately than is possible at present.

REFERENCES

Carroll, J.B. The prediction of success in intensive foreign language training. In R. Glaser (Ed.), Training Research and Education. Pittsburgh, University of Pittsburgh Press, 1962. pp. 87-136.

Carroll, J.B. A model of school learning. Teachers Coll. Rec., 1963, 64, 723-733.

Carroll, J.B. et al. A Parametric Study of Language Training in the Peace Corps. Cambridge, Mass.: Laboratory for Research in Instruction, Graduate School of Education, Harvard University, 1966.